

Full Length Research Paper

The incidence of human disease-causing fungi on Nigerian paper money

Kemka H. Ogbonda^{1*}, Ikpebievie Y. Oku², Austin A. Okwelle¹, and Tubo S. George¹

¹Department of Biology, Ignatius Ajuru University of Education, Rumuolumeni, PMB 5047, Port Harcourt, Nigeria

²Department of Biological Sciences, Niger Delta University (NDU), Wilberforce Island, Bayelsa State, Nigeria.

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Various denominations of the Nigerian paper money (₦5, ₦10, ₦20 and ₦50) were collected randomly from motorcyclists, market women, restaurant operators, and meat sellers (butchers) in Nigeria. The currency notes were examined for possible contamination by disease-causing fungi. Result showed that all the currency notes from the various categories of people studied were contaminated by fungal organisms. The fungi included four *Aspergillus* and one *Rhizopus* species. The ₦5 denomination had the highest incidence of the organisms. The currency notes from meat sellers were found to be the most contaminated. *Aspergillus* species cause the disease, *aspergillosis*, while *Rhizopus* species cause zygomycosis, in man. It is suggested that since currency notes could be vehicles for the transmission of infectious diseases of human, they should be handled more properly to avoid their being contaminated by disease-causing microorganisms. Paper money handling should include but not limited to carrying currency notes in wallets, envelopes and holding with clean hands. The promotion of a cashless economy is also advocated. Nigerian paper money has been found in this study to be contaminated with human disease-causing fungi and could be vehicles for the transmission of fungal diseases of man. They should be handled properly to prevent their being contaminated.

Key words: Abuse of currency notes, *Aspergillosis*, contamination, paper money, pathogens, public health, zygomycosis.

INTRODUCTION

Money is an invention of the human mind. Before the evolution of money exchange was done by barter, which involved the direct exchange of one good for some quantity of another good. The barter economy is a simple economy where people produce goods either for self-consumption or for exchange with other goods which they want. However, the barter system is inconvenient as it involves much effort on the part of people in trying to exchange goods for services.

In common usage money refers more specifically to currency, particularly the many circulating currencies with legal tender status. Paper money (or, paper currency) refers to notes of different denominations made of paper and issued by the central bank or the government of a

country. Paper money differs from country to country. For instance, the Nigerian currency notes come as five (5), ten (10), twenty (20), fifty (50), one hundred (100), two hundred (200), five hundred (500), and one thousand (1000) naira notes. Money, particularly paper money plays an important role in the daily life of consumers, producers, businessmen, traders, academicians, politicians, administrators, etc as a means of exchange. Because paper money is exchanged frequently, they deteriorate fast. Thus, the majority of people are exposed to dirty notes the notes get dirty as a result of poor currency-handling culture and abuse of currency notes. A great majority of the people does not carry money in wallets and squeezing of currency notes is common, especially among market women, motorcyclists, bus drivers and their conductors, butchers and meat sellers, restaurant operators, etc. For instance, women often place money underneath their brassier with sweat; men in their socks. Market men and women squeeze

*Corresponding author. E-mail:
kemkahumphreyogbona@yahoo.com.

currencies and put them into their dirty pockets.

Meat sellers in slaughter houses and in market places collect money from buyers with hands contaminated with blood and animal wastes. The case in restaurants is not different. In most parts of the world, it is believed that the simultaneous handling of food and money contributes to the incidence of food-related public health incidents (FSA, 2000). Over the last two decades, data indicating that the simultaneous handling of food and money could indeed be a cause of sporadic food-borne illnesses have accumulated from studies of the microbial status and survival of pathogens on coins and currency notes in Turkey (Goktas and Oktay, 1992); the United States (Dow Jones News, 1998; Jiang and Doyle, 1999; Pope et al., 2002); India (Singh et al., 2002); Egypt (El-Dars and Hassan, 2005); and Rangoon, Myanmar (Khin et al., 1989). Also, swabbing and culturing from various coins and paper currency collected at random from doctors, laboratory staff and other employees at a New York hospital in the US is said to have resulted in the recovering of many pathogenic microbes (Dow Jones News, 1998; FSA, 2000). In Australia, an assessment of the public health risk associated with the simultaneous handling of food and money in the food industry has revealed the possibility of currency contamination by microorganisms. Brady and Kelly (2000) analysed money handled by people who were also food handlers and established the presence of coagulate-positive staphylococci on the money surface.

Although paper currency is impregnated with certain antimicrobial agents such as mercuric iodide, there is still the possibility of the notes serving as vehicles for disease-organism transmission. People can still contact diseases through the handling of the currencies. The possibility of currency notes acting as vehicles for the transmission of potential pathogenic microorganisms was suggested in the 1970s (Abraham and Waterman, 1972). This is because paper currency is widely exchanged for goods and services all over the world. Every trade or transaction involves hand-on-money, with the lower denomination notes receiving the most handling because they are exchanged more often.

Paper currency serves as food substrates for certain microorganisms. For instance, the average US dollar, like most currency notes world-wide, lasts a mere 18 months (Spivack, 2005). Paper currency also provides a large surface area as a breeding ground for pathogens (Podhajny, 2004). Michaels (2002) has also noted that money (paper) in which pathogenic microorganisms might survive represents an often overlooked reservoir for enteric diseases.

Scientific (research) information on the contamination of paper money by microbial agents is lacking in most developing countries of Sub-Saharan Africa. This dearth of information may have contributed to the absence of public health policies or legislation on currency usage, handling and circulating in many parts of Africa.

This study was undertaken to examine some commonly used currency notes in Nigeria, for possible contamination by disease-causing fungi. Result will provide information about the public health risk of mal-handling or abuse of currency notes.

MATERIALS AND METHODS

Sample collection

Samples of Nigerian currency (paper money) comprising notes in the denominations ₦5, ₦10, ₦20 and ₦50, were collected from various categories of people, including meat sellers (butchers), market women, food sellers (restaurant operators) and motorcyclists in various parts of Nigeria. The samples were randomly obtained by purchasing an item or paying for a service using a large denomination, thus creating the need for balance (in smaller denominations) to be given. The balance was placed in sterile polyethylene bags, sealed and taken to the laboratory.

Examination of currencies for contamination by fungi

Each of the currency denominations (naira, 5 - 50) collected from various groups of people was cut aseptically into pieces using scissors. The pieces were placed onto the surface of malt extract agar in each of thirty-two petridishes (in duplicates), using sterile forceps. To the malt extract agar was added 30 µg/l aureomycin (antibacterial) to discourage bacterial growth. The agar plates were incubated at room temperature (approx. 27°C) for growth to occur.

Isolation and identification of fungi

After 4 days of incubation, individual fungal colonies were aseptically picked and sub-cultured. The isolated fungi were identified on the basis of colour and general morphology using light microscope.

RESULTS

Table 1 shows the distribution of the isolates in the various currencies collected from the various categories of people. Table 2 shows the frequency of occurrence of the isolates in the various currencies from all categories of people. The total frequency of isolates in all categories of currency is presented in Table 3. Figures 1 and 2 shows the percent occurrences of isolates in the various currencies and the various categories of people respectively.

Four *Asperillus* and one *Rhizopus* species were

Table 1. Distribution of isolates in the various currencies collected from the various groups.

Isolate	Identification	Motor cyclists/bus drivers (N)				Market women (N)				Restaurant Operators (N)				Meat sellers (N)			
		5	10	20	50	5	10	20	50	5	10	20	50	5	10	20	50
F1	<i>Aspergillus niger</i>		+	+	+	+	+	+	+			+	+	+		+	+
F2	<i>Aspergillus fumigatus</i>	+		+	+			+	+					+			+
F3	<i>Aspergillus terreus</i>	+				+		+		+						+	
F4	<i>Aspergillus clavatus</i>		+	+		+	+	+		+	+			+	+		
F5	<i>Rhizopus sp.</i>	+	+				+	+	+	+							+

Table 2. Frequency of occurrence of the isolates in the various currencies from all categories of people.

Isolate	Frequency of occurrence,			
	₦5	₦10	₦20	₦50
<i>Aspergillus niger</i>	1	2	4	4
<i>Aspergillus fumigatus</i>	4	2	2	4
<i>Aspergillus terreus</i>	4	0	1	0
<i>Aspergillus clavatus</i>	3	3	2	1
<i>Rhizopus species</i>	1	2	1	2
Total	13	9	10	11

Table 3. Total frequency of isolates in all categories of currency.

Isolate	Frequency of occurrence in various categories of people				
	Motor cyclists/bus drivers	Market women	Restaurant Operators	Meat sellers	Total
<i>Aspergillus niger</i>	4	3	3	4	14
<i>Aspergillus fumigatus</i>	3	3	2	4	12
<i>Aspergillus terreus</i>	1	1	0	0	2
<i>Aspergillus clavatus</i>	2	2	3	2	9
<i>Rhizopus sp.</i>	1	2	1	2	6
Total	11	11	9	12	43

isolated from the paper money studied. The result showed that all the currency notes studied were contaminated by the fungal organisms. *A. niger* and *A. fumigatus* were the most contaminants of the currency notes. In like manner the currency denomination that was mostly contaminated was the ₦5 note (Table 2).

DISCUSSION

The results of the study showed that all the currency notes studied were contaminated by fungal organisms. This is not unexpected. Money and paper money especially, is widely exchanged, from one person to another, and with poor conditions of handling. This

exposes the notes to unsanitary conditions and contaminating organisms. This is supported by studies world-wide. For instance, swabbing and culturing from various coins and paper currencies collected at random from doctors, laboratory staff and other employees in a New York hospital resulted in the recovery of many pathogenic microbes (Dow Jones, 1998; FAS, 2000). Again, an attempt to assess the public health risk associated with the simultaneous handling of food and money in food handlers showed the presence of high levels of microorganisms (Brandy and Kelly, 2000). That the ₦5 currency was the most contaminated in this study is probably because it is the most exchanged, hand-to-hand. Results also showed that currency notes from meat sellers were the most contaminated (Table 3 and

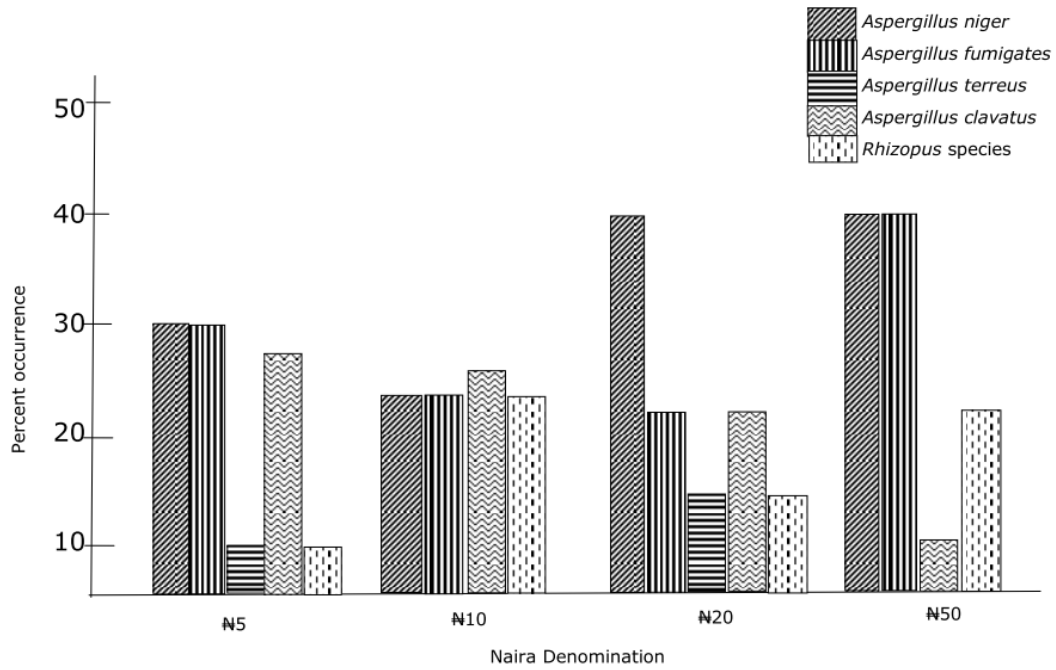


Figure 1. Percentage occurrence of isolates in the various currencies.

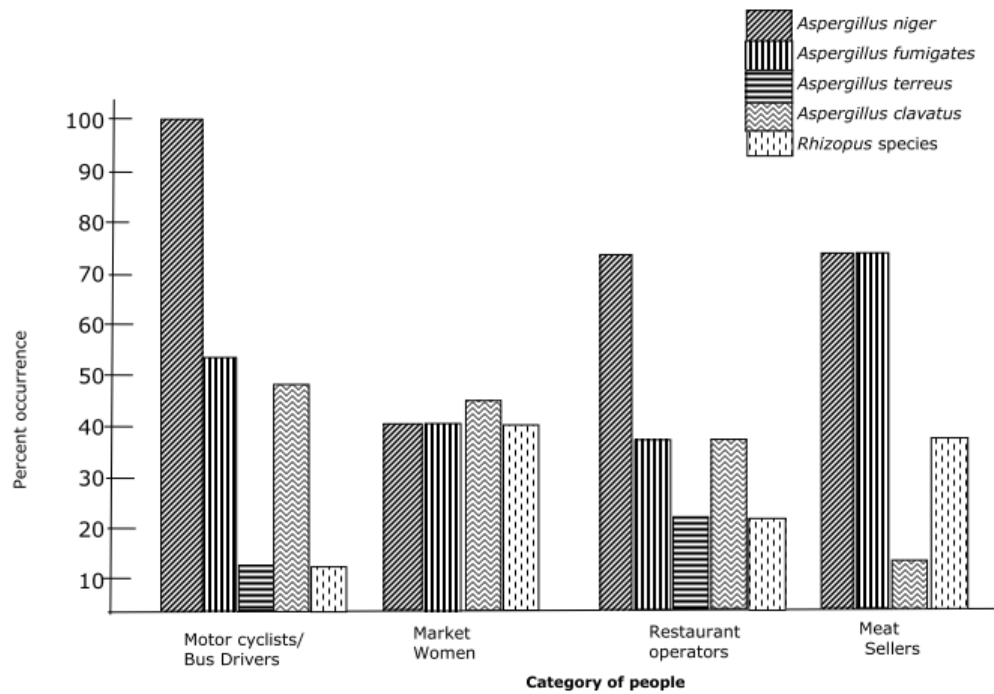


Figure 2. Percentage occurrence of isolates in the various categories of people.

Figure 2). This could be attributed to the fact that in Nigeria, sanitation facilities at slaughterhouses and meat markets are grossly inadequate. A visit to any

slaughterhouse or meat market anywhere in Nigeria suffices as proof. This results to a very poor sanitary environment, which enhances cross contamination from

simultaneous handling of money and animal products.

Aspergillus species constituted 80% of the fungal contaminants of currency notes. This may be due to the fact that *Aspergillus* organisms are ubiquitous and quite adaptable to various environmental conditions. Also, they produce enormous numbers of spores that are air-borne and which survive long periods of dryness. *Aspergillus* species are notorious human pathogens, causing a disease known as Aspergillosis in man (Anderson and May, 1991; Brandy and Kelly, 2000). The symptoms of aspergillosis include allergic bronchopulmonary aspergillosis (ABPA), aspergilloma (AGM), and invasive aspergillosis (IA). The manifestations of ABPA range from asthma to fatal destruction of the lungs with defined clinical, serological, radiological, and pathological features.

Aspergilloma symptoms include haemoptysis, which results from the disruption of blood vessels in the wall of the cavity occupied by the fungus. Most frequently, it leads to internal bleeding. Invasive aspergillosis has become a leading cause of death, mainly among haematological patients. Its average incidence is estimated to be 15 to 25% in patients with acute leukemia. Invasive aspergillosis is recognized today as the main fungal infection in cancer patients. Its four different manifestations are acute pulmonary aspergillosis, tracheobronchitis and obstructive bronchial disease, acute invasive rhinosinusitis, and disseminated diseases commonly involving the brain and other organs, e.g. skin, kidneys, heart and eyes. Generally, diseases caused by *Aspergillus* species (aspergillosis) are known to be common among immunosuppressed individuals, such as organ-transplant and AIDS patients and are frequently fatal. The diseases occur when an immunosuppressed individual inhales conidiospores (spores) of the organism and the body responds to their presence.

Rhizopus species cause a group of diseases referred to as zygomycosis. Zygomycosis includes mucocutaneous, rhinocerebral; genitourinary, gastrointestinal, pulmonary and disseminated infections (Anderson and May, 1991).

The abuse, misuse, or improper handling of currency notes goes with the possibility of these notes serving as vectors or vehicles for the transmission of the disease-causing fungi. It is, therefore, suggested that currency notes be properly handled and/or stored to prevent them from being contaminated by microorganisms. Proper handling should include carrying in wallets, envelopes, etc. Efforts should also be intensified towards the promotion of a cashless economy.

Conclusion

This study has revealed that the improper handling of money, particularly paper money, exposes the money to

contamination by disease-causing fungi. Paper money (currency notes) are, therefore, veritable sources of fungal infection of humans. The improper handling (or, abuse of) currency notes should, therefore, be seen as a dangerous habit or practice.

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